

Washington State Department of Transportation

Statewide Snow and Ice Plan

November 1, 2006

This document supersedes the November 1, 2005 Snow & Ice Plan

Executive Summary

The Washington State Department of Transportation (WSDOT) manages all State routes, US routes and Interstate highways throughout Washington State. The climate in the state is extremely diverse, from temperate rain forests to high mountain passes, to desert-like plateaus and almost everything in between. During the winter months, snow and ice control plays a significant role in safely transporting the traveling public and facilitating the movement of goods and services. The “Snow and Ice Plan” provides guidance and direction to assist in safe, efficient, and consistent operations throughout the state. In addition, this plan will help WSDOT to move toward a “Chemical Priority Program” in order to support consistent Levels of Service (LOS) between regions and maintenance areas within the state. This statewide Snow and Ice Plan will be supplemented with six regional plans and multiple maintenance area plans which will provide details on how statewide plan goals will be accomplished at the local level. The attached plan encompasses six main sections:

Roadway Treatment Goals: Delineated by color, shows different roadway sections within the state and establishes recommended treatment levels that will be applied to roadway sections to maintain consistency throughout the state, regardless of region or maintenance area.

Winter Maintenance Accountability Process (MAP) for Snow and Ice, LOS, and Data Collection Procedures: Describes the process used to evaluate the level of service achieved for the winter season and outlines the data collection process used to record all sand, solid, and liquid deicer applications. Describes two weather forecasting services provided to WSDOT.

Snow and Ice Training and Chemical Slipperiness Guidelines: Describes our training program, a checklist for annual review, guidelines for operation of wing plows, and a memorandum on chemical slipperiness. These guidelines provide direction regarding when chemical deicers should and should not be used.

Statewide and Regional Storage and Road Weather Information Systems (RWIS) Sites: Includes a series of maps showing winter maintenance facilities and RWIS sites statewide and by region.

Field Testing and Sampling Procedures: Defines consistent sampling procedures to be followed to ensure we are getting quality deicing products that meet Pacific Northwest Snowfighters (PNS) specifications.

Chemical Application Guidelines: Federal Highway Administration (FHWA) established recommendations for application of different chemicals in a variety of different weather conditions and temperatures ranges.

This plan is a dynamic document that will be revised and updated over time with input from numerous sources. The 2006 Snow and Ice Plan will be accessible in an electronic format through the WSDOT intranet at:

http://wwwi.wsdot.wa.gov/MaintOps/pdf/SI_PlanNovember04-1_06.pdf or on the Internet at: http://www.wsdot.wa.gov/maintenance/pdf/Snow_and_Ice_plan06.pdf . For questions or comments, please contact M&O Branch Manager Tom Root at: roott@wsdot.wa.gov or 360-705-7587

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SECTION 1

2006-2007

ROADWAY TREATMENT GOALS

2006-2007 Roadway Treatment Goals

Due to the dynamic nature of winter weather and resultant road condition variations, WSDOT maintenance personnel will use a variety of treatments to control snow and ice at different times in different places. Results of snow and ice control treatments will vary depending on a number of factors including severity and type of winter weather, program funding levels, geography, traffic levels, traffic speeds, and support facilities (i.e. liquid chemical storage tanks). While results can be measured in a variety of ways, the motoring public most often gages maintenance efforts in terms of road conditions during and immediately after inclement weather.

Maintenance personnel rate roadway conditions during the winter season (see performance measure chapter). This information can be used to project expected road conditions associated with different snow and ice treatment levels. The variable and unique nature of individual winter weather events limits the relevance of projected expectations on a per-storm basis. When ratings from an entire winter season's storm events are averaged, however, the ratings become a reliable indicator of the LOS provided by maintenance for the winter season.

Inherent differences in winter climate between Eastern and Western Washington mean that road treatment levels may vary. As limited funding requires prioritization of different roads for snow and ice control services, different treatments will be employed for individual roads and sections of roads.

For the purpose of this Snow and Ice Plan, "Bare Pavement" is defined as a wet pavement surface free of most, but occasionally not all ice, slush, or snow. After snowplows clear snow from a travel lane, some of the surface area of a travel lane may have scattered remnants of ice, snow, or slush remaining. This is still considered a "Bare Pavement" condition.

Eastern Washington Treatment Goals:

In Eastern Washington, the winter season is typified by periodic snowfall events, freezing temperatures for the duration of the winter season, and generally drier conditions. This drives the maintenance approaches of more extensive anti-icing (because there is less precipitation in the form of rain to wash it away), and more snow removal. The winter maintenance program (labor, equipment, and materials) is sized and developed to facilitate the movement and safety of traffic under normal expected winter conditions. The exceptional winter weather event in Eastern Washington is typically a severe, wide spread ice storm or a snowstorm of very severe intensity, duration, and expanse. Since this happens infrequently, it would be an inefficient management of resources to size and base a winter maintenance program for this type of exceptional winter weather event, as would be an excess of equipment and workforce sitting idle for most of the winter season.

The WSDOT program is based on history and the expected average conditions of winter for Eastern Washington. Therefore, when the rare, extremely severe winter weather occurs, the program is unable to respond to the accustomed level due to a "shortage" of resources. The short-term consequences of this scenario would be far outweighed by consequences of wasted resources if the program were sized and based on the worst case scenario.

Western Washington Treatment Goals:

In Western Washington, diverse microclimates are numerous. Typically the winter season lasts from mid to late November thru early March. The weather is generally wet with cool, moderate and occasional icy events. The winter maintenance program (labor, equipment, and materials) is sized and based to facilitate the movement and safety of traffic under normal expected winter conditions. This will typically be when temperatures drop and create black ice or frost conditions. A light to moderate snowfall event may also occasionally take place. These are typically characterized by localized events. The exceptional winter weather event in Western Washington is typically a heavy snowstorm, short in duration over a wide geographic area. Since this happens very infrequently, it would be an inefficient management of resources to size and base a winter maintenance program for this type of exceptional winter weather event, as there would be an excess of equipment and workforce sitting idle for most of the winter season.

The WSDOT program is based on history and the expected average conditions of winter for Western Washington. Therefore, when the rare, heavy snow storm occurs, the program is unable to respond to the accustomed level of service due to a "shortage" of resources and gridlock caused by heavy traffic volumes in the urban areas. The short term consequences of this scenario would be far outweighed by consequences of wasted resources if the program were sized and based on the worst case scenario.

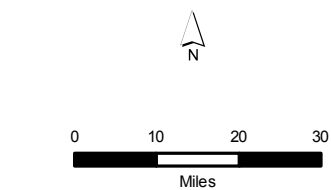
Treatment Level Goals	Washington State Description of Roadway Treatment Actions
Level 1	<ol style="list-style-type: none"> 1. Pre-treat as conditions allow with anti-icing chemicals before a forecast snow, black ice, frost or freezing rain / mist event. 2. Apply anti / deicing chemicals to roadway if snow is accumulating to try to keep snow from compacting and bonding to pavement. 3. If compact snow and ice or heavy black ice forms on the roadway, apply pre-wet solid chemicals to the surface to try to break up the snow/ice for removal.
Level 2	<ol style="list-style-type: none"> 1. Pre-treat as conditions allow with anti-icing chemicals before a forecast snow, black ice, frost or freezing rain / mist event. 2. Applications of anti / deicing chemicals to roadway if snow is accumulating to try to minimize snow compacting and bonding to pavement. 3. If compact snow and ice or heavy black ice forms on the roadway, apply combination of sand and / or deicing chemicals to try to provide traction and assist in the breakup and removal of snow/ice.
Level 3	<ol style="list-style-type: none"> 1. Pre-treat as conditions allow with anti-icing chemicals before a forecast snow, black ice, frost, or freezing rain / mist event. 2. If snow accumulates, plow with or without the moderate use of sand and / or solid deicing chemicals. 3. Treat existing amounts of compact snow and ice with the moderate use of sand and / or solid deicing chemicals.
Level 4	<ol style="list-style-type: none"> 1. Limited pre-treatment of anti-icing chemicals for snow, black ice, frost or freezing rain as conditions allow. 2. If snow accumulates, plow with or without the limited use of sand and / or solid deicing chemicals. 3. Treat existing amounts of compact snow and ice by plowing with the limited use of sand and / or solid deicing chemicals.
Level 5	<ol style="list-style-type: none"> 1. Treat like Level 4 roads while open. 2. Road will remain passable as conditions allow. 3. Road closed when conditions dictate.

1 = Prior to Weather Event 2 = During Weather Event 3 = After Weather Event

EASTERN WASHINGTON TREATMENT LEVEL



Latest version: 06/27/2006
Supersedes Previous Editions



TREATMENT LEVEL

Level 1

Level 2

Level 3

Level 4

Level 5

Major Lakes

Regional Boundaries

County Boundaries

WSDOT Maint. Facility

Eastern Washington
Snow and Ice Plan
Roadway Treatment Goals
June of 2006



**Western Washington
Snow and Ice Plan
Roadway Treatment Goals
2005**

0 20
Miles

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5
- WSDOT Maintenance Offices
- County Boundaries
- DOT Region





**Puget Sound
Snow and Ice Plan
Roadway Treatment Goals
2005**

0 10
Miles

- | | |
|---------|-----------------------------|
| Level 1 | ★ WSDOT Maintenance Offices |
| Level 2 | ● CityTest |
| Level 3 | --- County Boundaries |
| Level 4 | ▭ DOT Region |

Section 2

**Winter MAP Snow and Ice
Level of Services (LOS)**

&

Data Collection Process

&

Statewide Weather Forecasting

Winter MAP Snow and Ice Data Collection

Performance Measure: The performance of the Maintenance Program as Snow and Ice control activities are conducted is measured in terms of the results of these activities. The most important, overall result for snow and ice control is the condition of travel lanes provided by maintenance actions (i.e. sanding or deicing) during winter conditions (i.e. snow, ice, frost). Performance measure information is used to determine the LOS provided by the Maintenance Program throughout a given winter season. LOS ratings can be determined on different scales that range from statewide to route-specific.

When: Road conditions are assessed after chemical or sand applications are made during the winter season. There are no specified days or times during which road conditions should be documented. This documentation should be made after a sand or chemical application is completed and the intended result (i.e. bare pavement) has had a chance to materialize. Maintenance personnel should document road conditions as they drive over previously-treated roads in the course of their daily work as opposed to making a special trip to a roadway location solely to document road conditions.

Where: Roadway conditions that result from maintenance actions can be documented at any location where a treatment was applied.





How: Maintenance personnel conduct the condition assessments by observing the condition of a roadway (all lanes, both directions). Observations are documented on the winter maintenance Personalized Digital Assistant (PDA) application/database.

Ratings: Different road conditions are assigned different point values. The point values are used to calculate the LOS ratings. There are two classes of road conditions on the form that represent the two primary ways that WSDOT provides snow and ice control services. One is to enhance traction on top of snow/ice by spreading abrasives (i.e. sand) on the travel lane. The other is to attempt to provide a bare pavement surface by applying chemicals to the travel lane. Point values for different conditions are as follows with commensurate LOS ratings:

Road Condition Rating for Sand Treatment	Points	LOS Rating
100% of roadway has sand present	3	C+
50% or more of roadway has sand present	3.5	C
All emphasis areas have sand present	4	D+
50% or more of emphasis areas have sand present	5	F+
50% or less of emphasis areas have sand present	5.9	F
Unable to evaluate	-	-

Road Condition Rating for Chemical Treatment	Points	LOS Rating
Bare Pavement	1	A+
Patches of frost, black ice, slush, or compact.	1.5	A
Wheel tracks bare, frost, snow, or ice encountered.	2	B+
50% of roadway with compact snow and ice.	3	C+
Entire roadway covered with compact snow and ice.	4	D+
Unable to evaluate	-	-

Note: Emphasis Areas include hills, bridges, curves, intersections and known problem areas.

Expected Season LOS	Expected Road Condition after Treatments Completed	
A to B	Snow or ice buildup encountered rarely. Bare pavement attained as soon as possible. Travel delays rarely experienced.	
B to C	Snow or ice build up encountered at times but infrequently. Travel at times may experience some isolated delays with roads having patches of black ice, slush, or packed snow.	
C to D	Snow or ice buildup encountered regularly. Travel likely to experience some delays with roads having black ice or packed snow with only the wheel track bare.	
D to F	Compact snow buildup encountered regularly. Traveler will experience delays and slow travel.	
N/A	Closed periodically or for the duration of the winter season.	

Snow and Ice Data Collection



In the fall of 2002, WSDOT embarked on a mission to manage the snow and ice portion of the maintenance program more effectively. Prior to this time, there was no standard for data collection or information storage documenting what we did, where we made applications, when we applied material, how much we applied, who applied the material, and the results of our efforts. Information retrieval was a cumbersome process and could take weeks or months.

Our first attempt to standardize data collection for the snow and ice program came in the fall of 2002 when a small input computer program was written to run on a PDA. The main criteria for this effort were the ease of use by the equipment operator and the common data elements collected. The implementation was limited in scope due to the small number of PDAs available, but was positively received by those employees that used them.

The Department is solving the lack of PDAs by systematically buying and deploying units every year. By sharing units there are enough PDAs to accomplish the collection of the current winter data. Regions will continue to add PDAs as funding becomes available to accomplish the vision of one PDA for each employee.

Feedback from employees since implementation has been instrumental in redeveloping the system. The current version now includes many information elements on drop down menus that

previously had been entered by the employee, such as a materials list, an equipment list and State Route number list. Furthermore, the new application is customizable to the employee or the organization. They can limit the number of items the drop down menus display to those elements that they use most frequently for quicker data entry. The current version incorporates the MAP LOS rating and is based on the type of material applied, sand or chemicals. This will give the Department more opportunities to evaluate the results of the work we do and will give us data we can use to improve our methods.

Another part of the data collection system resides on the WSDOT intranet. Here records can be reviewed, corrected, and reported. The web site address is: <http://dothqrd03:8080/>. Click on Winter Activities to access the application.

Statewide Weather Forecasting

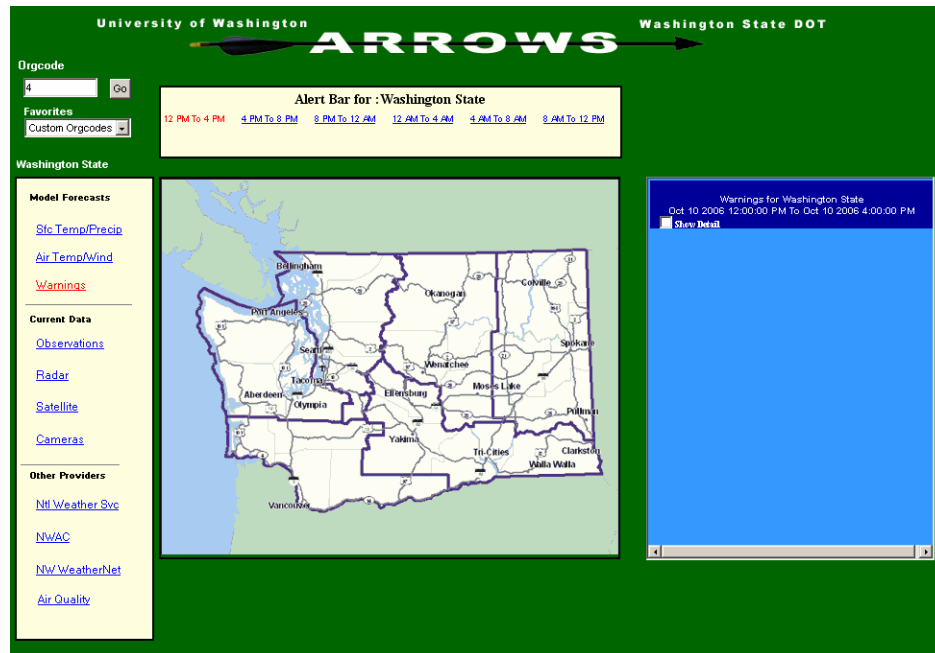
Weather forecasting plays a major role in all of our maintenance organizational decisions. Accurate weather forecasting is critical for our winter operations to make good management decisions on when to schedule crews and when to apply or not to apply anti-icers or deicers to the road surface. Virtually every decision made in winter operations has a direct relationship to the weather.

The State of Washington uses two primary weather forecasting providers to make winter weather decisions. Weathernet Inc. is one forecast provider WSDOT uses to provide statewide year round, 24 hours a day, 7 days a week, tailored weather forecast service and 24 hour a day support consultation via toll free phone lines to WSDOT Maintenance personnel. Text forecasts (of an agreed upon format), are generated twice daily, from Monday through Sunday during the winter months, from October 1st through April 30th. Summer season forecast are issued once each day from Monday through Friday, from May 1st through September 30th. Forecast include narratives for all maintenance areas and site-specific forecasts for each maintenance section within the maintenance area. Written forecasts are made available to authorized persons on Weathernet Inc. website, and sent via email or in some cases faxes to requested locations. In conjunction with forecast duties, the on-site Weathernet meteorologist will monitor weather conditions throughout the state and will alert appropriate WSDOT personnel of any changes to the forecast as well as imminent hazardous developments. These meteorologists will answer any weather related questions posed by WSDOT personnel. In addition, Weathernet meteorologists are expected to archive forecasts and communications contacts as well as document storm events for future evaluations.

Northwest Weathernet Inc. Statewide Maintenance Forecast



WSDOT also uses ARROWS(Automated Real-time ROad Weather System), a product of the University of Washington, to forecast weather events. This weather forecast system is generated by computers and all associated data will be archived for future reference.



Reference guide to using the ARROWS forecast system

To start, type in your org code and click “go”

There are four main parts to the web page:

- Alert bar/time selection (top center, above map)
- Main menu (left side)
- Map window (center)
- Detail window (right side)

Alert Bar

The time period in view is controlled within the Alert Bar at the top of the page. Clicking on a different time period will change the time of the displayed data.

If any weather alerts have been issued, a large red “!” (exclamation point) will appear on the Alert Bar within the appropriate time period.

Main Menu

Several types of forecasts can be viewed by clicking on the options under Model Forecasts. Sfc Temp/Precip shows maps of precipitation overlaid on top of color coded maps of pavement temperature. All of the different Model Forecast maps have selective points which can be clicked for a detailed 24-hour forecast. On the Warnings maps, if there is a warning at one of these points, it will be red on the map; otherwise all points are shown in green or blue.

The options for “Current Data” provide displays of several current data items. Clicking on Observations will display RWIS observations on the map window and a list of weather sites in the detail window, along with current conditions. Clicking on a site, either on the map or the detail window’s list will open a new window with observation from that location over the past 24 hours. The Cameras option will show clickable camera locations on the map, and a list in the details window. Above the list is a link to Thumbnails, which opens a new window showing shrunk images from all cameras, organized by route.

The “Other Providers” portion of the main menu contains links to websites from the National Weather Service, Northwest WeatherNet, and others.

Map and Detail Windows

These windows show the data selected from the Main Menu at the time selected from the Alert Bar. The Map Window shows the data graphically, the Detail Window shows it in text. Both windows contain clickable links to provide access to more detailed data at specific points.

Section 3

Snow and Ice Training Program & Chemical Slipperiness Memorandum

Training

With the increasing complexity of statewide snow and ice control, training of WSDOT personnel is a high priority. The complexity and cost for snow and ice control demand that our staff have the best tools and training available to ensure the safety for our traveling public. The current snow and ice training program consists of the following:

Annual Review of Snow and Ice Procedures:

- A Procedures Checklist
- An Automated Training Management Systems (ATMS) roster.

A crew or area meeting should take place before winter and include all permanent and temporary field personnel. Supervisors/lead techs should check each item on the checklist and review them during meeting. Each employee will then sign or initial the ATMS roster for the review and return the checklist and roster to the Region Maintenance Training Coordinator (RMTTC).

On the Job Training:

On the job training is an extremely important part of our training program. This is done routinely, especially with temporary or new employees within every state maintenance area. Each maintenance area will be responsible for documenting all on the job training conducted within their respective area.

Wing Plow Training:

This training program consists of classroom and hands-on operational training, which is provided by regional training staff. All employees who will be operating a wing plow must complete this training and be certified as a wing plow operator. Refresher training will be amended and will be covered and documented in the “wing plow” portion for the Annual Review of Snow and Ice Procedures.

Snow Camp:

These two or three day workshops are designed specifically to focus on Eastern and Western Washington winter conditions. Two Snow Camps (one East and one West) will be held in the Fall of each year. Snow Camp provides a number of functions: to understand the Snow and Ice Plan, to encourage employee networking across regional boundaries, to share ideas and to learn about the latest technology and procedures in winter operations. Individual regions will determine target attendees, however, as seminar size is generally limited to 60 to 90 individuals. Tech III and Lead Techs may be the ideal audience so that these individuals rotate through the Camp every two to three years. A course code has been developed for this seminar. Teams of RMTTCs sponsor this event annually.

Snow College:

This is a comprehensive three day interactive course presented by consultants or University staff. Targeted attendees are maintenance supervisors and above. These courses will be scheduled for the summer of 2007.

Annual Review of Snow and Ice Procedures

Safety

- ☐ 1) Develop and/or review pre-activity safety plans for winter related operations
- ☐ 2) Injury Procedures
 - a) Reporting personal accidents (see chapter 6 of the Safety Manual)

Coordination

- ☐ 1) Radio procedures
 - a) Road and Weather Reports
 - b) Reporting Accidents
 - c) Etiquette
- ☐ 2) Plow routes and responsibilities
 - a) Who's doing what and where
- ☐ 3) WSP call out procedures/priority system
 - a) Responding to accidents and incidents
- ☐ 4) City and State responsibility
 - a) Snow removal
 - b) How to plow within city jurisdiction (where to put snow)

Policies and Directives

- ☐ 1) Maps
 - a) Level of service
 - b) Roadway condition goals
 - c) Roadway priorities
- ☐ 2) Sanding policies
 - a) When and where to use abrasives
 - b) Spinner shut on and off
- ☐ 3) Chemical application
 - a) Timing of applications (humidity and temp.)
- ☐ 4) Procedures for stranded motorist
 - a) Towing policy
 - b) Calling for help
 - c) Transporting passengers
- ☐ 5) Media policies
 - a) Talking to the media
- ☐ 6) Public relations
 - a) Talking to the public (why we do what we do)
- ☐ 7) Mailbox replacement
 - a) Criteria for replacement
- ☐ 8) Winter scheduling including contingency
 - a) Call out procedures
 - b) Assignments

Chemical Applications

- ☐ 1) Chemicals currently being used
 - a) How do they work
 - b) When to apply
 - c) When to re-apply or not
 - d) Rates
 - e) Timing
 - f) Application areas
 - g) Areas of priority
 - h) Using pre-wet
 - i) MSDS info

Equipment

- ☐ 1) Plowing
 - a) Techniques
 - b) Timing
- ☐ 2) Wing plows
 - a) Policies
 - b) Procedures
- ☐ 3) Chemical application techniques
 - a) Solid
 - b) Liquid
- ☐ 4) Calibration of equipment
 - a) Abrasives
 - b) Liquid
- ☐ 5) Procedures for Installations
 - a) Plow
 - b) Other attachments
- ☐ 6) Loaders
 - a) Operations
- ☐ 7) Equipment procedures
 - a) Reporting deficiencies
 - b) After hour breakdowns

Record Keeping

- ☐ 1) PDA
 - a) Refresher on use
- ☐ 2) Inventory procedures
 - a) Tracking
- ☐ 3) Snow and Ice database
 - a) Application records
- ☐ 4) After Action Reports
 - a) Documenting what works and where

Weather

- ☐ 1) Weather resources
 - a) List weather sources
 - b) RWIS and ARROWS refresher

Environmental

- ☐
 - a) Review BMP's
 - b) Application locations (Fish Sticks)
 - c) Stockpile management (containment)
 - d) Other

Signature

Date

Wing Plow Operational Guidelines

Pre- Operational Check List:

1. **Inspect** components for the following:
 - Plow and plow frames for cracks, broken welds or loose bolts. Safety chains and bits for wear and general condition.
 - Plow pins for washers and cotter pins.
 - Hydraulic lines, fittings, and cylinders for damage or leaks.
 - Safety chain security for transporting.
 - Tower slide lubrication.
 - Bolts and push beam anchor bolts, lift cable for fraying and proper tension.
 - Rear mounting plate and wing brace vertical supports for bends, loose bolts or cracks.
 - Wing extension push arms adjustment. These should accommodate road width.
 - Controls for smooth and correct operation.
2. **Repair or replace** any items found to be deficient. Be sure to know what size wing is on your truck..
3. **Check** the condition of the plows periodically during the shift and inspect at shift end.

Lowering the Wing

1. Be certain area is clear and the safety chain is removed.
2. Set toe (leading edge) to approximately 6 inches above the pavement.
3. Lower the heel (trailing edge) to approximately 6 inches above the pavement.
4. Lower the wing evenly to the pavement and allow a small amount of float at the float link.

Raising the wing

1. In an urgent or emergency situation use the wing lift switch on the joy stick, or manually raise the toe and heel until the wing is fully raised.
2. Raising and lowering may be performed with the vehicle in motion.
3. When approaching railroad crossings, slow down and raise the wing so as not to hook into tracks.
4. Slack in the tower cable will cause a delay when raising the wing.

Safe Operating Practices

1. The Supervisor of the area should develop a site-specific plan for wing plow operation (“Wing Caution Zones”). There are obstacles. Know where they are.
2. Important: refrain from unhooking the safety chain on the wing until the engine has been started and the hydraulics on the wing are pressurized, because the cylinder may not support the wing until charged.
3. Do not operate a plow unless you are qualified, trained and understand how to operate the vehicle and the controls.
4. An operator not qualified to operate a wing plow can operate the truck and front plow as long as the wing is safely chained and not used.
5. Adjust your plowing speed to the conditions, e.g. obstacles, traffic volumes, pedestrians, highway conditions, grade, terrain and visibility.
6. Use caution when plowing around obstacles. If in doubt raise the wing.
7. When roadway features are too narrow to accommodate the use of the wing without lane changes, raise the wing plow.
8. Do not use the wing in weather conditions where visibility is adversely affected, such as heavy fog or whiteout conditions.
9. It is not recommended you wing on soft surfaces such as gravel shoulders. If you do wing on soft surfaces, do so only after slowing to a safe speed and adjusting the wing lift to prevent the wing from penetrating the soft shoulder material. (Float link adjustment)
10. Do not use the wing plow to widen out shoulders. The operator cannot see the plow tip well enough to make the fine adjustments necessary to perform this job safely.
11. Do not use the wing if traffic or highway conditions are not suitable for safe operation.
12. When using the wing plow, remain constantly alert to traffic and roadside obstacles.
13. It is recommended to carry ballast and use tire chains if needed when using the wing plow.
14. Do not park or leave the unit without either securing the safety chain if the wing is up, or lowering the wing to the ground.
15. Slowing down and downshifting instead of raising the wing will help maintain your plow pattern and reduce the time to clear the travel way.
16. When plowing alone with the wing plow, use the front plow and the wing plow in the same direction. Plow only the right lane and the shoulder. Do not use as a “V” plow.
17. When plowing in tandem in multi-lane areas with median snow storage, it is recommended that at least one truck plow to the left a few hundred feet in front of the wing unit. This plow pattern provides a clear path left of the wing truck for motorist inclined to pass.
18. When gang plowing (3 or more trucks), position the wing plow unit where the wing can be buffered or protected by one of the other plow trucks in the formation. Regional direction

will dictate whether or not the wing may be used in the center or left lanes. Check with your supervisor for proper guidance.

19. Safety chains are not designed to keep the wing tight against the side of the vehicle. Wings can move out even with safety chains properly attached. This is especially true on ten-wheelers.
20. When storm conditions so impair visibility that the centerline is difficult to find, discontinue use of the wing plow.
21. Do not rub guardrail with the wing. The leverage exerted on the wing can turn the truck toward the rail. Be aware that when the wing is in the up position, it still extends past the edge of the front plow and can strike obstacles that the front plow will clear. Check rear support arm for breakaway bolts.
22. Use a block to prevent accidental raising of the wing whenever the truck or plow is being worked on.
23. When mapping wing plow caution zones, don't forget to include expansion joints on bridges. Check plow angle vs. joint angle.

November 1, 2006

Memorandum

TO: Maintenance Engineers/ Superintendents

THROUGH: Chris Christopher

FROM: Tom Root

SUBJECT: Chemical Slipperiness

Because of the potential for slippery conditions to be caused by misapplication of liquid anti-icing chemicals to roadway surfaces, the following guidelines should be utilized:

Applying anti-icing chemicals and humidity:

Applying liquid anti-icing chemicals to roadway surfaces can potentially cause a “slurry” phase during the drying process, which can result in slippery road conditions. This “slurry” phase generally occurs when the anti-icing chemicals transform from a liquid to a solid state or back from a solid to liquid state. This “slurry” phase takes place quickly and is generally short in duration. The greatest potential for a slipperiness problem is when road temperatures are in the 40’s and the relative humidity is between 45 and 50%. Research shows the common denominator for most incidents investigated are road temperatures between 40⁰ and 54⁰ degrees F (most often at 46⁰ F) and a relative humidity of approximately 45-50%. The slurry transition phase can also occur at relatively low humidity levels (below 35%). These conditions typically occur in the fall and generally involve an application of liquid anti-icing chemical prior to the first freezing event of the season. Therefore:

- 1) Users should not apply anti-icing liquids for a winter event if the air temperature is above 40 degrees with a relative humidity of 45 to 50 %. If these conditions exist, delay the application until temperatures drop.
- 2) If humidity is (or expected to drop) below 35%, application rates should be reduced. Using the WSDOT anti-icing chemical application guideline matrix, apply at the lowest recommended rate.
- 3) Most occurrences of slipperiness involved an application made between noon and 3pm. If it is necessary to make an application around these times, temperature and humidity levels must be verified prior to an application.

Applying anti-icing chemical after an extended dry spell:

When a liquid anti-icing application has been made after a long dry spell, the build up of oil-based residuals left from vehicles and the application of a liquid to the roadway can produce a slick surface. This is very similar to a light rain shower on a roadway surface after an extended dry spell. The chemicals used for anti-icing are heavier than water and may displace any petroleum-based residuals on the roadway surface. The chemical itself may not cause the slipperiness, but may be a contributing factor in a reduced friction surface.

Considering the risk of developing slick conditions, users should be cautious when applying anti-icing liquids after an extended dry spell. Additionally, using lower application rates may reduce the risk of slipperiness developing under these conditions. Using the anti-icing chemical application guideline chart, located in the November 2006 WSDOT Snow and Ice Plan, apply at the lowest recommended rate.

Multiple applications:

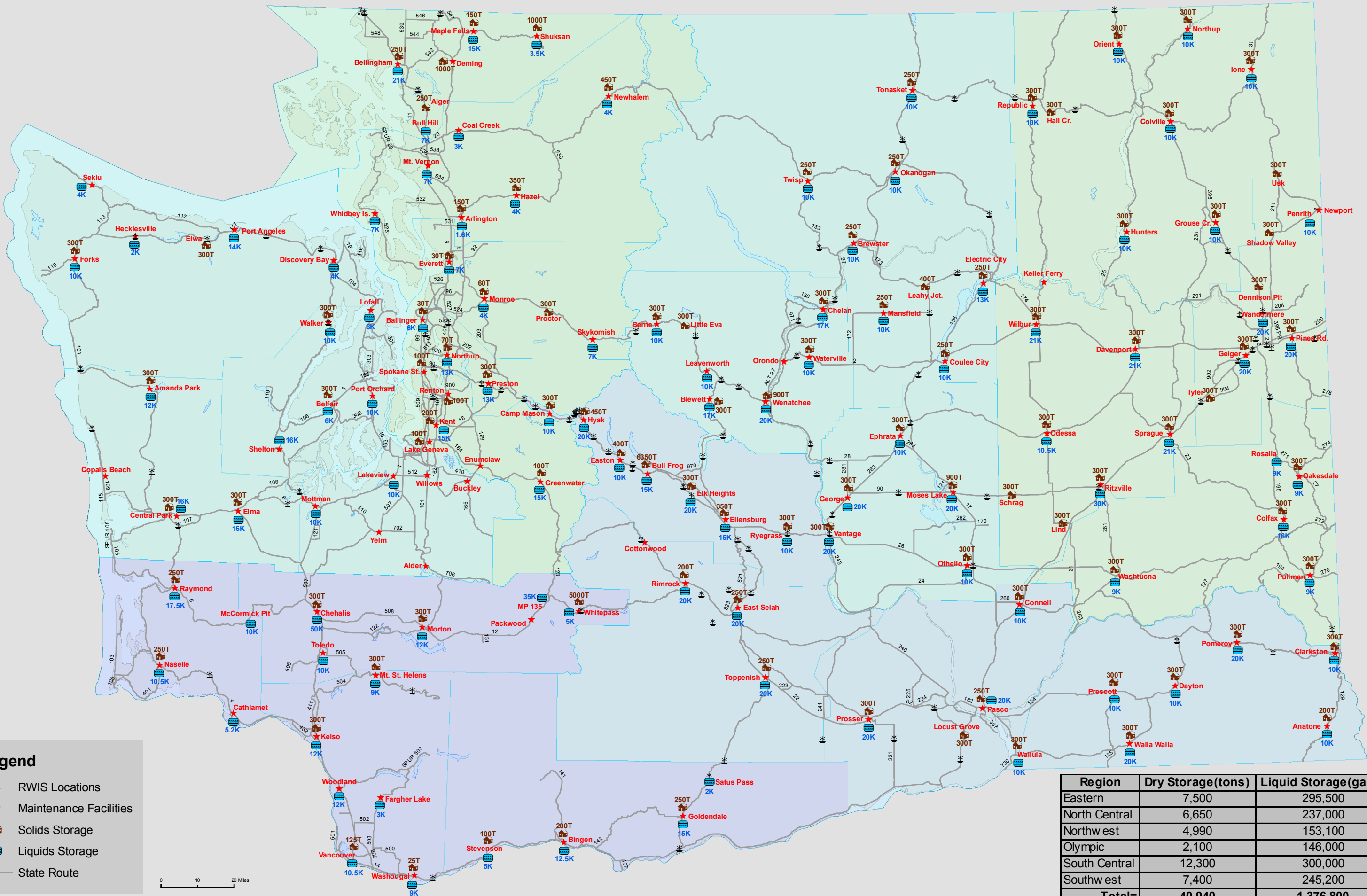
If anti icing liquid chemicals are being applied on multiple, back-to-back applications, the application rate should be reduced on subsequent applications. Reducing the application rate will prevent excess chemical buildup on the roadway. However, the rate should not be reduced if excess moisture or high traffic volumes have diluted the initial application.

Section 4

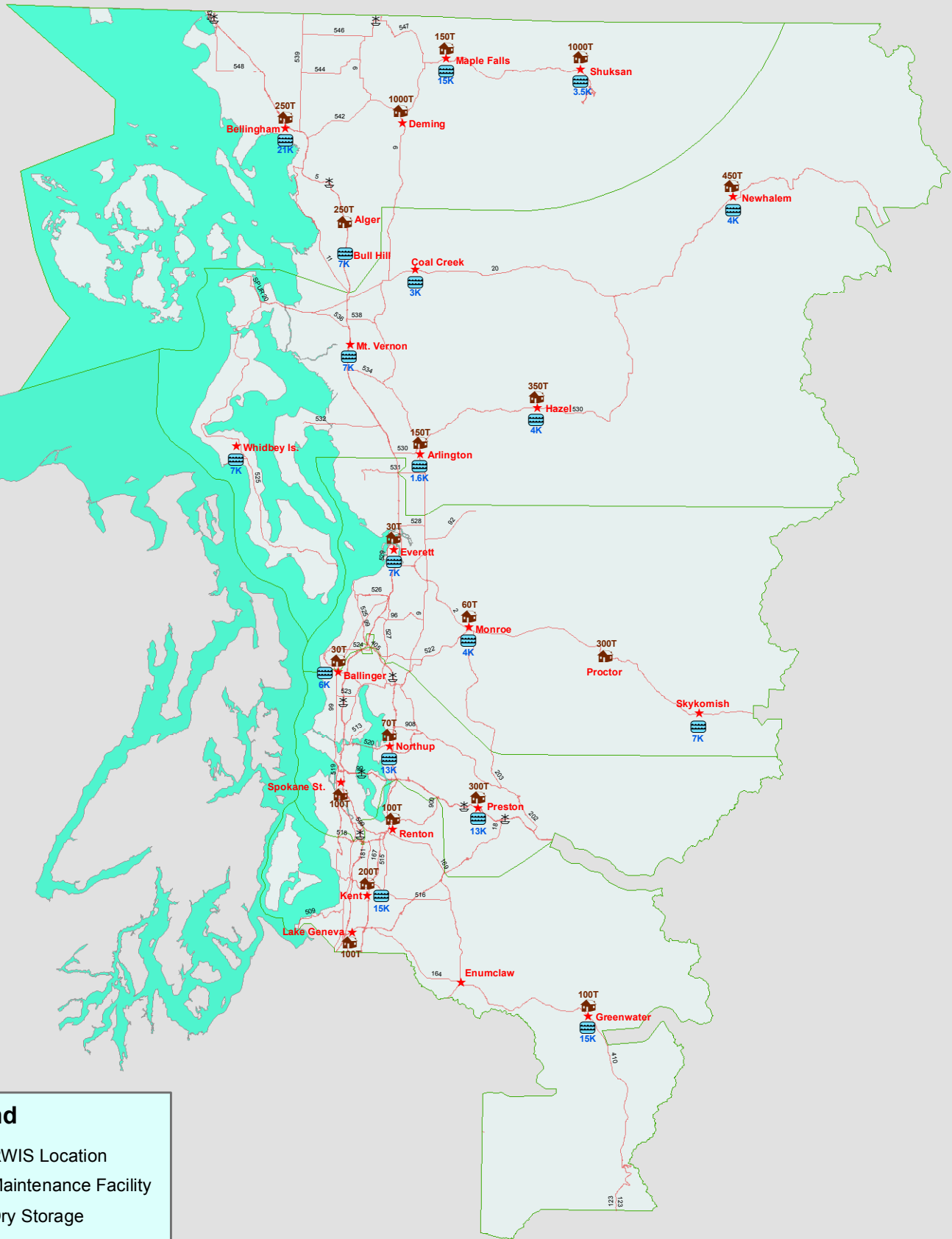
Statewide Storage and RWIS Maps

&





Regional Storage and RWIS Maps



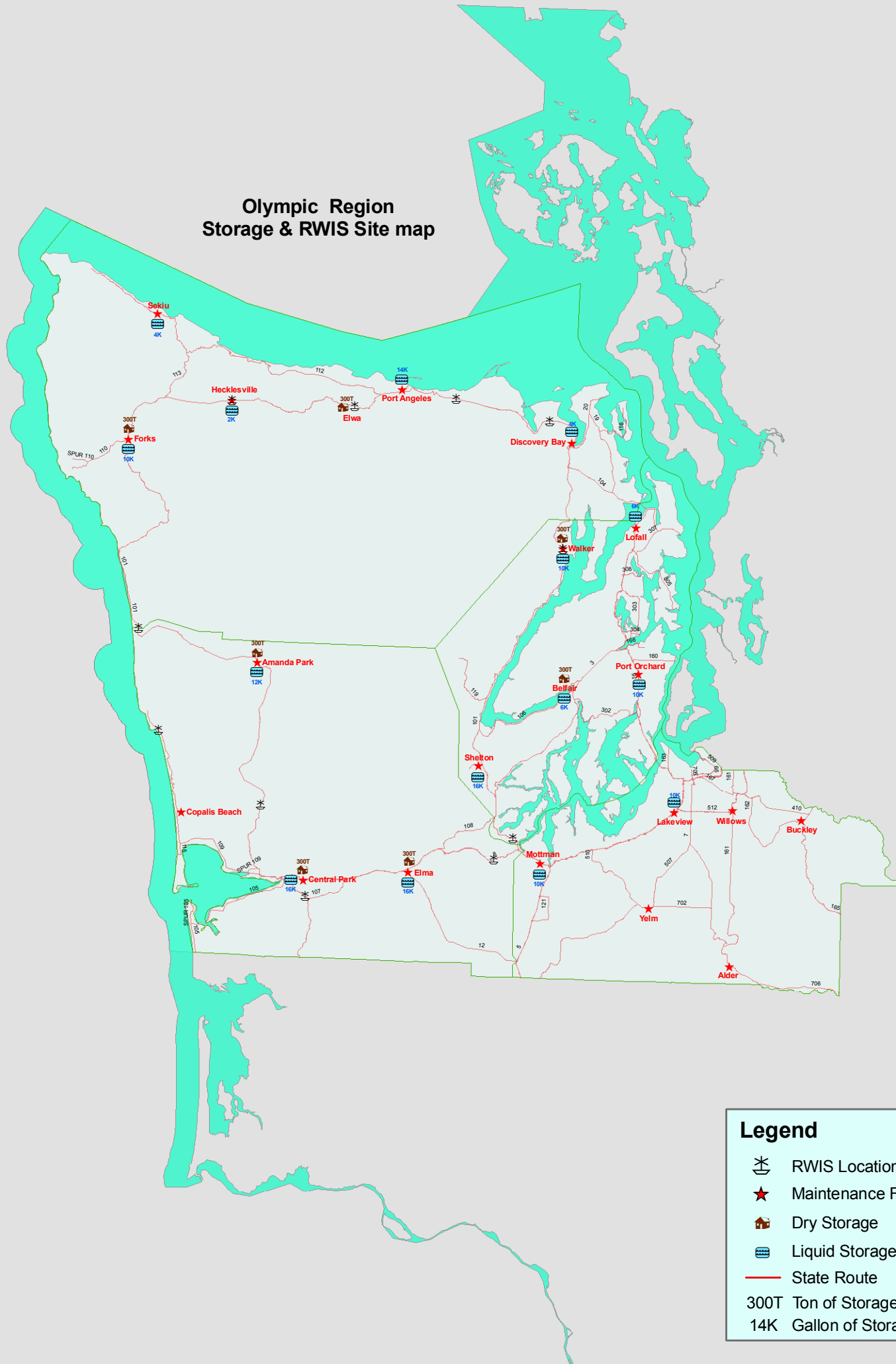
Northwest Region Storage & RWIS Site Map



Legend

-  RWIS Location
-  Maintenance Facility
-  Dry Storage
-  Liquid Storage
-  State Route
- 150T Ton of Storage
- 10K Gallon of Storage

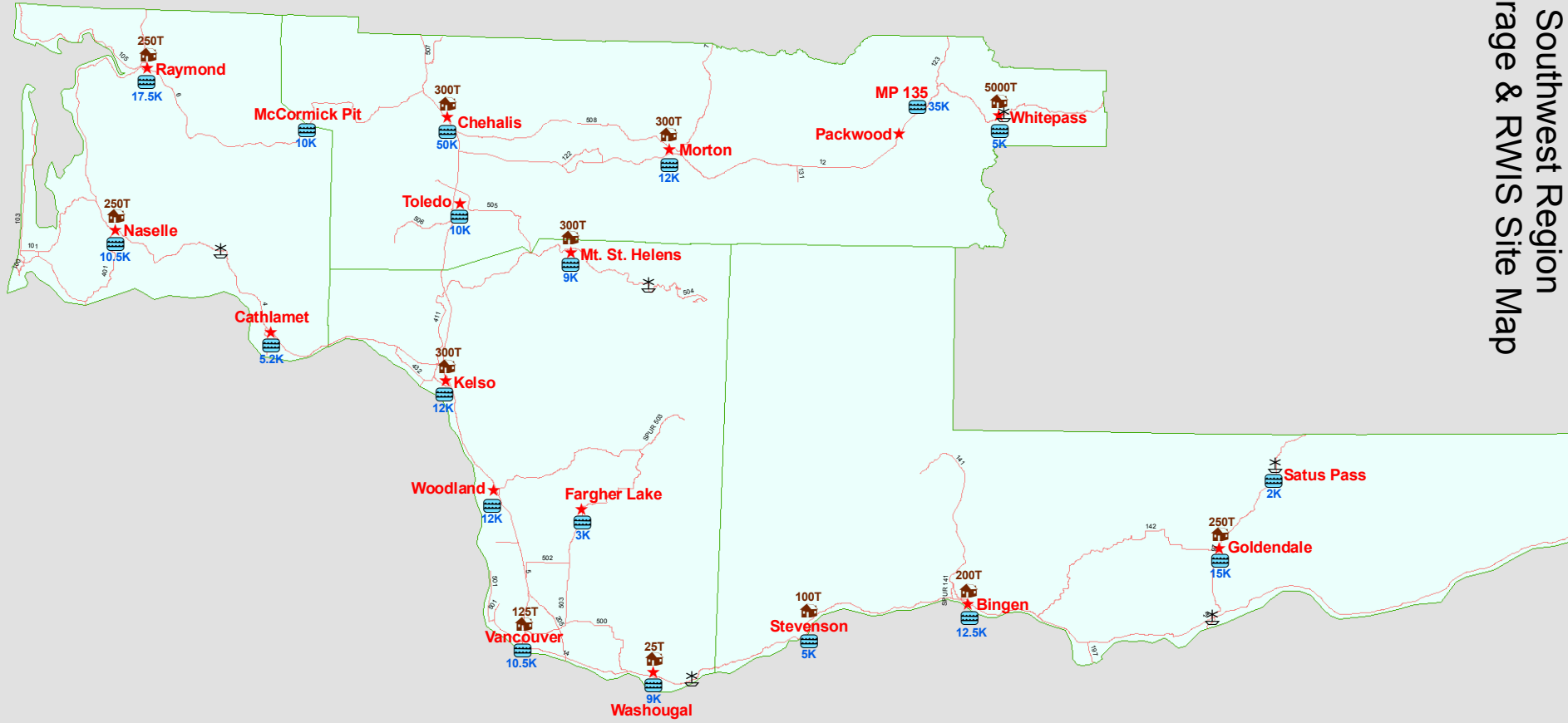
Olympic Region Storage & RWIS Site map



Legend

- RWIS Location
- Maintenance Facility
- Dry Storage
- Liquid Storage
- State Route
- 300T Ton of Storage
- 14K Gallon of Storage

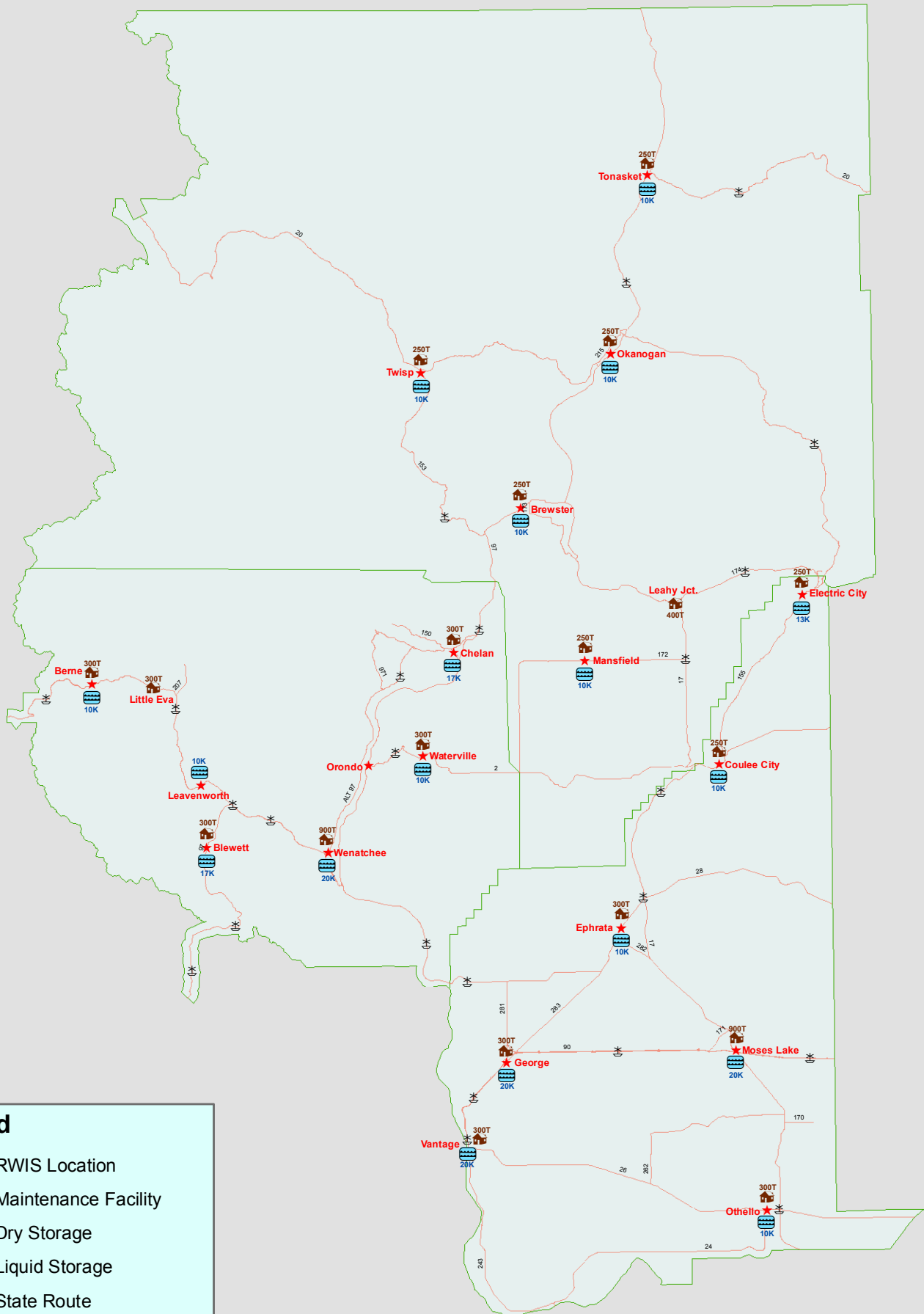
Southwest Region
Storage & RWIS Site Map







Legend

- RWIS Location
- Maintenance Facility
- Dry Storage
- Liquid Storage
- State Route
- 300T Ton of Storage
- 20K Gallon of Storage

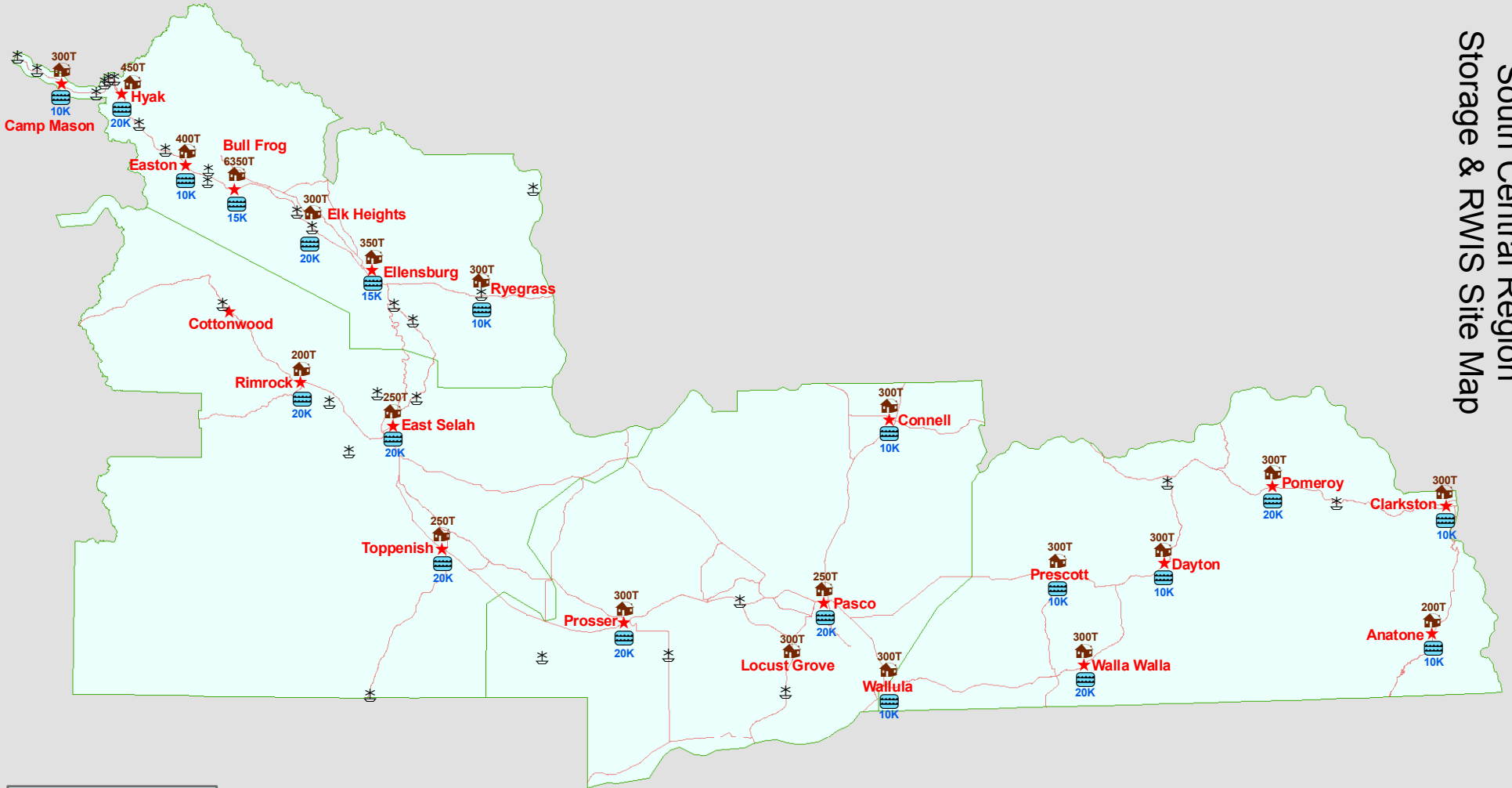
North Central Region Storage & RWIS Site Map








Legend

-  RWIS Location
-  Maintenance Facility
-  Dry Storage
-  Liquid Storage
-  State Route
- 300T Ton of Storage
- 20K Gallon of Storage

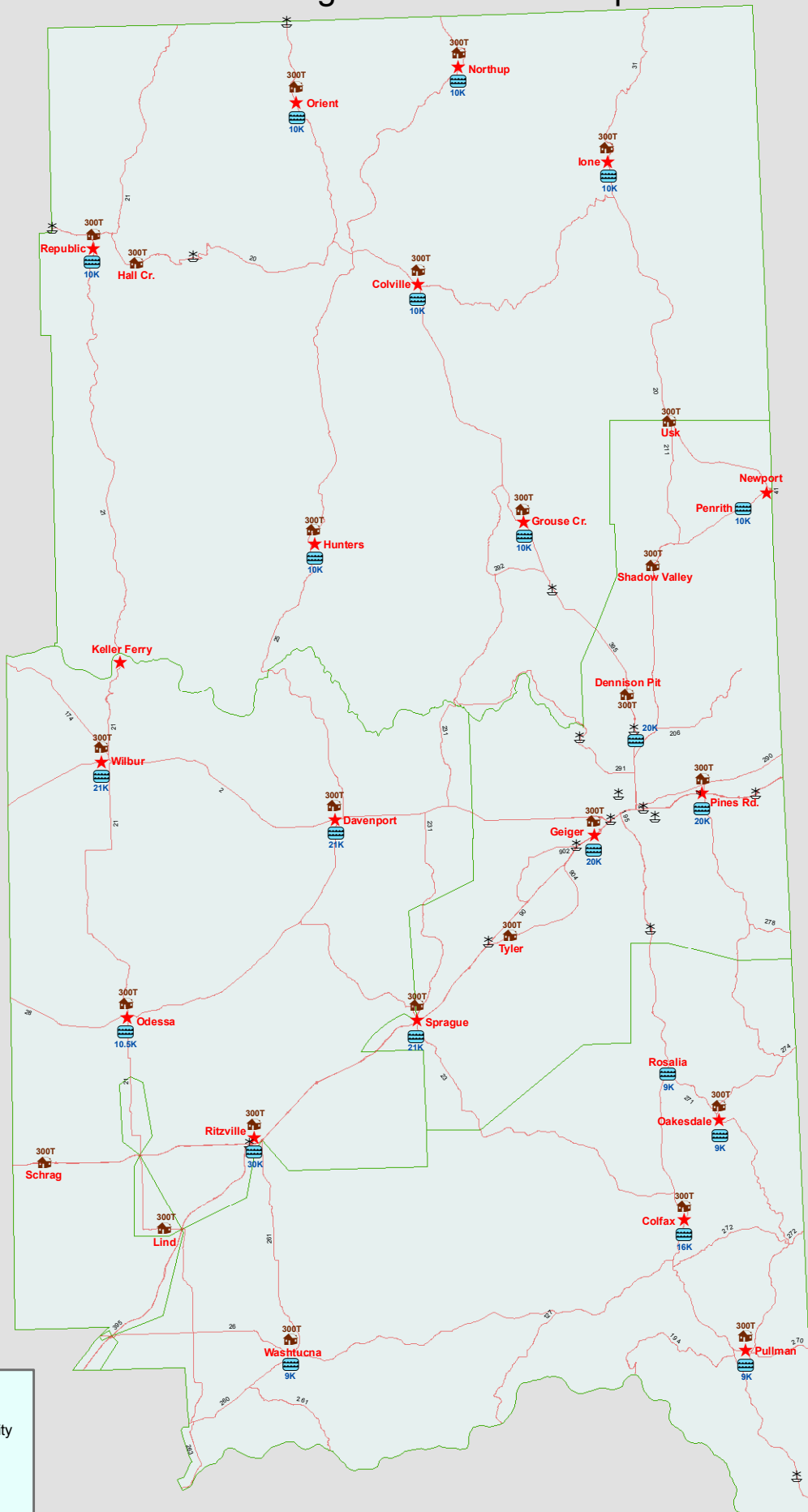
South Central Region Storage & RWIS Site Map



Legend

-  RWIS Location
-  Maintenance Facility
-  Dry Storage
-  Liquid Storage
-  State Route
- 300T Ton of Storage
- 14K Gallon of Storage

Eastern Region Storage & RWIS Site Map



Legend

- RWIS Location
- Maintenance Facility
- Dry Storage
- Liquid Storage
- State Route
- 300T Ton of Storage
- 20K Gallon of Storage

Section 5

Field Testing and Sampling Procedures

Field Testing and Sampling of Anti-Icing/Deicing Chemicals

The following guidelines are provided to help assist the anti/deicing chemical testing and sampling accuracy and consistency program conducted by field personnel. If there are any disputes with chemical vendors, certain procedure of documentation is necessary to ensure compliance with the current chemical contract.

When to take a chemical deicer sample:

Take a one-gallon sample from every tanker load of liquid chemical deicer received. For dry products, take one sample for every field order, or with orders exceeding 300 tons, take one sample for every 300 tons delivered. For liquid samples, it is recommended that a plastic container with a small lid be used to minimize product leakage. Use electrical tape to further seal the container to prevent leakage. For dry samples, a wide-mouth plastic container would be appropriate. Store samples on-site for future random testing or in the case of “Just Cause.” For “Just Cause,” take two samples, retain one and send in the second to the WSDOT Materials Lab. Be sure to notify your supervisors of any problems immediately. Have someone from the affected Maintenance Area contact Tom Root at headquarters (360-705-7857) to notify him that a “Just Cause” sample has been sent in for testing.

In the case of any disputes from Materials lab findings:

Archived samples will help to determine the extent of product failure. If lab failures start to occur, specific sites will be asked to send additional samples to the Headquarters Materials Lab from your stored samples taken at time of delivery. If lab failures continue, notification will be sent to all areas using that “failed” product. Additional lab testing will be done until the chemical meets specifications or corrective action has been completed.

Procedures Checklist:

A copy of the Sampling Procedures Checklist needs to be kept at all locations receiving chemical deliveries (Appendix 2). This checklist may be needed along with the Product Sampling Transmittal Form (Appendix 1) in case of disputes with lab findings or to determine the extent of product failure. **Keep copies of these forms and the filled out versions at the Maintenance Area offices.**

Field Inspection: Before allowing any product to be unloaded, it is necessary to adhere to the following procedures:

1. Document and maintain records on all deliveries, including those that are rejected. This may include the following:
 - a) Date of the order
 - b) Date and time of delivery
 - c) Verification of advance delivery notification
 - d) Delivery within allowable times
 - e) Name of delivery company and license plate numbers.
 - f) Product being delivered is what you ordered.
 - g) Document all significant procedures prior to unloading of product
 - h) All papers required of a delivery exist, are complete, and legible.

2. Visually inspect the load to determine if there are any obvious reasons why the load should be rejected.
3. Verify separation or non-separation of product.
4. No excess foreign material, floating in the liquid or settled on the bottom, will be accepted. Any problems must be noted at the point of delivery. Notification must be relayed to Maintenance Area Management and at Headquarters for assistance.

Unloading

If all required information is in order and the product appears to be correct as ordered, document the amount of product currently in storage prior to unloading and begin the unloading process.

1. **Specific Gravity:** For liquid products, the specific gravity needs to be checked **prior to unloading**, to verify compliance with the specification. If the delivery truck has the ability to circulate the load, do so for five minutes prior to taking the sample for a specific gravity test. Specific gravity, weights and concentrations for all contract products are in Appendix 3.
2. **Acceptable Limits:** Per the state contract, the concentration can be off by plus or minus one percent. If your load is not within the specification, then you should take a second sample. If the second sample fails, contact the vendor and discuss with your supervisor whether or not the load should be rejected. Product specification guidelines are located in Appendix 3.
3. **Unloading Issues:** Visually inspect the delivered product again while unloading. If problems are noted that are a cause for rejection of the load, immediately halt the unloading process. Take photos if applicable and record any pertinent information.

Conduct the following procedures if the material is to be rejected:

- a) If there is a problem and reloading can not be done, (mixed with previous material) note the amount of product (liquid only) pumped into the tank and total product now present in the tank.
- b) Circulate the tank and then pull two one-gallon (4-Liter) samples of the contaminated deicer material now in the tank.
- c) Check and record the specific gravity of the samples.
- d) Secure the product as needed to assure its integrity. Determine if all products on hand will have to be removed.
- e) Send samples directly to Jeanne Andreasson, Chief Chemist at the Headquarters Materials Laboratory.
- f) Immediately advise the Regional Purchasing Officer of any ordering, delivery, storage, or product quality issues.

Rejecting Loads:

The level of authority to reject a load should be decided at the start of the season before deliveries commence. If the decision is made to reject a load, notify the vendor and the Region's Purchasing Officer before the load is sent back. A list of current contract supplier and their phone numbers are in Appendix 3

Shipping:

Containers sent to the Headquarters Materials Lab must be clean and free of leaks. They must be properly packaged and secured before shipment to prevent contamination and spillage. The deicer transmittal form must be included with the material sample.

Appendix # 1: Deicer Sample Transmittal Form

Contracts: # 07904 / 06805 “Road Snow and Ice Control Products”

HQ Lab # _____

Lab Contract Number: MS 363901, Work Op 2199, Org 343022

Sampling Person: _____ Date: _____

Location: _____ Region: _____

Contact Person: _____ Phone: _____

Chemical Deicers (Check One):

Category 1 (Magnesium Chloride): Ice Stop CI 2000 _____

Category 2 (Calcium Chloride): Geomelt CT _____

Category 4 (Inhibited Sodium Chloride): Ice Slicer Elite _____

Category 7 (Calcium Magnesium Acetate): CMA _____

Category 8a (Uninhibited Sodium Chloride): Cargill White Salt _____

Category 8b (Uninhibited Sodium Chloride): Ice Slicer RS _____

Experimental or Other Category: _____

Additional Information Required From Maintenance Area:

Product Tested: _____ Quantity Delivered _____

Date of Order: _____ Date of Delivery: _____

Advance Delivery Notification? Yes _____ No _____

Time of Delivery Acceptable? Yes _____ No _____

Delivery Location: _____ Lot Number _____

Shippers Name: _____

Trucking Company: _____ License Plate: _____

Sampling Procedures:

1. The Tester has a copy of the Current Procedures on Hand? Yes___ No___
2. Has the Material been Circulated (if Applicable)? Yes___ No___
3. Specific Gravity or Weight Verified before Unloading? Yes___ No___
4. Specific Gravity of Pre-Sample:_____
- First Attempt: Pass___ Fail___ Second Attempt: Pass___ Fail___
5. Sample Size meets agency Requirements (1 Gallon Minimum) Yes ___No___
6. Location of Tank or Stockpile where the Product is off loaded:_____
7. Sample Labeled as Required? Yes ___No___

Signature of Tester_____ **Date**_____

Comments / Observations:

Send Samples to Headquarters Material Lab: Attention Jeanne Andreasson, Chemist

Samples via WSDOT Courier: Mail Stop 47365

Samples by U.S. Postal Service: PO Box 47365 Olympia, WA 98504 (or)

Sending by Fed X or UPS: 1655 South 2nd, Tumwater, WA 98512

Appendix # 2: Sampling Procedures Checklist

Visual Inspection of Delivered Loads: Prior to unloading or receiving shipment:

- For liquid products, take Specific Gravity reading.
- Insure that there is no product separation.
- Ensure that there are no precipitates or foreign objects floating in solution or settled on the bottom of the container.
- For Dry products, look for foreign material, large chunks, or excess moisture.
- If the material appears not to meet specifications, contact maintenance supervisor or management for direction on shipment load acceptance.

Sample Requests / Procedures:

- * **Dry Bulk Deicing Materials:** Take 1 Sample randomly for every field order per site. Mix representative samples from middle loads and retain in a 1 gallon, wide mouth sample container for testing. For field orders exceeding 300 tons, contact Headquarters for instructions.
- * **Liquid Deicing Materials:** Take 1 Sample/Tanker Load
Mix in clean, 5 gallon bucket samples from the beginning, middle and end of load and retain testing sample in a clean, 1 gallon narrow mouth jug.
- * **Save Sample** in Maintenance Area storage shed until notified by Headquarters.
- * **Random Samples** will be called for by Headquarters throughout the season .
- * **Ship Random Samples** to Jeanne Andreasson at the MATs Lab (below).
- * **Problems with Loads**, automatically ship “For Cause” to MATs Lab for testing and notify Supervisors and Headquarter.
- * **Non-compliant loads** that appear visibly out of spec, take additional samples and notify Supervisors and Headquarters.
- * **Mark Sample Containers:** Use a Black Felt Tip Pen and Write Legibly
State Contract Number (# 07904 everything except Categories 4 or 8a)
(# 0 6805 for Category 4 and Category 8a).

Product Name
Date Sample Taken
Lot Number
Specific Gravity
Sampling Person/Phone Number
Sample Location

Product Analysis:

Once the MATs lab has completed their tests, they will notify Headquarters and Headquarters will then let affected areas and vendors know the outcome. If there is product non-compliance, Headquarters will work with State Procurement, WSDOT Purchasing and the affected areas on any liquidated damages that are due back to those affected areas.

Send Samples to Headquarters Material Lab: Attention Jeanne Andreasson, Chemist

Samples via WSDOT Courier: Mail Stop 47365

Samples by U.S. Postal Service: PO Box 47365, Olympia, WA 98504 (or)

Sending by Fed X or UPS: 1655 South 2nd, Tumwater, WA 98512

Appendix #3: Product Specifications

VENDOR	CONTACT PHONE #	CHEMICAL NAME	PRODUCT NAME	PERCENT CONCENTRATION	SPECIFIC GRAVITY SPECIFICATIONS	WEIGHT SPECIFICATIONS Lbs/Gal.
Dustbuster	800-550-4276	Magnesium Chloride	Freeze Gard Zero CI-Plus	30%	Lower Limit 1.25	Lower Limit 10.5
					Target Limits 1.29-1.31	Target Limit 10.85
					Upper Limit 1.32	Upper Limit 11.00
America West	888-547-5475	Calcium Chloride Magnesium Chloride Potassium Chloride Sodium Chloride	GeoMelt CT	27.80% 3.26% 0.97% 1.32%	Lower Limit 1.28	Lower Limit 11.0
					Target Limits 1.34-1.35	Target Limit 11.2
					Upper Limit 1.37	Upper Limit 11.5
Cryotech	800-346-7237	Calcium Magnesium Acetate	CMA	Recommended @ 25%	Lower Limit 1.14	Lower Limit 9.5
					Upper Limit 1.16	Upper Limit 10.0
Envirotech	800-577-5346	Non-Chloride	NC-3000	25%	Lower Limit 1.30	Lower Limit 11.0
					Upper Limit 1.30	Upper Limit 11.5

Appendix # 4: Deicing Product Sampling Containers

To order sampling containers and other testing materials please refer to the VWR catalog:

Dry Deicing Products: 1 Gallon (5 liter) Wide Mouth Containers

VWR Catalog Number EP 350-04 WWM (4 for \$ 19.38)

VWR Catalog Number 16125-967 (4 for \$ 24.49)

Liquid Deicing Products: 1-Gallon Narrow Mouth Containers

VWR Catalog Number 16089-001 (4 for \$21.31)

Caps: 16199-180

Label Master Part Number UAC128PS (\$ 7.67 / ea (or) \$ 6.91 / 26+)

Hydrometers: VWR Catalog Number 34640-003

Hydrometer Cylinders: VWR 24661-255

Suppliers:

VWR Contact Information: 1-800-932-5000

Label Master: 1-800-621-5808

Section 6

Chemical Application Guidelines

WSDOT ANTI-ICING CHEMICAL APPLICATION GUIDELINES

1. INTRODUCTION

This is a guide for WSDOT highway anti-icing operations for maintenance field personnel. Its purpose is to suggest maintenance actions for preventing the formation or development of packed and bonded snow or bonded ice during a variety of winter weather events. It is intended to complement the decision-making and management practices of a systematic anti-icing program, resulting in roads that can be efficiently maintained in the best possible condition. Deviation from these guidelines is permitted when Region or Maintenance Area's guidelines are published within their own Snow and Ice Plan. These Regional/Area guidelines better represent practices unique to their own local geographical location.

This guide is based upon the FHWA "Manual of Practice for an Effective anti-icing Program" and the "National Cooperative Highway Research Program" (NCHRP) 6-13. The Manual of Practice for an Effective anti-icing Program provides the results of four years of anti-icing field-testing conducted by 15 State highway agencies and supported by the Strategic Highway Research Program (SHRP) and the FHWA. This guide also uses information obtained from the National Cooperative Highway Research Program (NCHRP) 6-13. Both manuals provide application rates for Sodium Chloride (NaCl). This Guide has been prepared to show equivalent application rates for Calcium Chloride (CaCl₂), Magnesium Chloride (MgCl₂), and Calcium Magnesium Acetate (CMA).

2. GUIDANCE FOR ANTI-ICING OPERATIONS

Guidance for anti-icing operations is presented in Tables 1 to 6 for six distinctive winter weather events. The six events are:

1. Light Snow Storm
2. Light Snow Storm with Period(s) of Moderate or Heavy Snow
3. Moderate or Heavy Snow Storm
4. Frost or Black Ice
5. Freezing Rain Storm
6. Sleet Storm

The tables suggest appropriate maintenance actions to take during either an initial or subsequent (follow-up) anti-icing operation for a given weather event. Each action is defined for a range of pavement temperatures and an associated air temperature trend. For some events, the operation is dependent not only on the pavement temperature and trend, but also upon the pavement surface or traffic condition at the time of the anti-icing action. Most of the maintenance actions involve chemical applications in a dry solid, liquid, or pre-wetted solid form. Application rates or "spread rates" are given for each chemical option to be used appropriately. These are suggested values and should be adjusted, if necessary, to achieve increased effectiveness or efficiency, for local conditions. Application rates in volumetric units (gal/lane-mi) are calculated from dry chemical rates. Comments and notes are given in each table where appropriate to further guide the maintenance field personnel in their anti-icing operations.

3. GLOSSARY OF TERMS

Black Ice: Popular term for a very thin coating of clear, bubble-free, homogeneous ice which forms on a pavement with a temperature at or slightly above 32°F when the temperature of the air in contact with the ground is below the freezing-point of water and small slightly super cooled water droplets deposit on the surface and coalesce (flow together) before freezing.

Freezing Rain: Super cooled droplets of liquid precipitation falling on a surface whose temperature is below or slightly above freezing, resulting in a hard, slick, generally thick coating of ice commonly called glaze or clear ice. Non-super cooled raindrops falling on a surface whose temperature is well below freezing will also result in a glaze.

Frost: Also called hoarfrost. Ice crystals in the form of scales, needles, feathers or fans deposited on surfaces cooled by radiation or by other processes. The deposit may be composed of drops of dew frozen after deposition and of ice formed directly from water vapor at a temperature below 32°F (sublimation).

Light Snow: Snow falling at the rate of less than 1/2 in per hour; visibility is not affected adversely.

Liquid Chemical: A chemical solution; the volume of solution applied per lane mile is the chemical application rate used in this appendix.

Moderate or Heavy Snow: Snow falling at a rate of 1/2 in per hour or greater; visibility is significantly reduced.

Sleet: A mixture of rain and snow, which has been partially melted by falling through an atmosphere with a temperature slightly above freezing.

Slush: Accumulation of snow, which lies on an impervious base and is saturated with water in excess of its freely drained capacity. It will not support any weight when stepped or driven on but will “squish” until the base support is reached.

Pre-wetting: The practice of applying liquid chemical to dry material before it is placed on the pavement

Dry Chemical Spread Rate: For solid chemical applications, it is simply the weight of the chemical applied per lane mile. For liquid applications it is the amount of liquid chemical applied per lane mile.

Table 1. Weather event: LIGHT SNOW
Using a 32% concentration of Calcium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/l ⁿ -mi) Liquid CaCl ₂	Maintenance Action	Chemical spread rate (gal/l ⁿ -mi) Liquid CaCl ₂	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM... plow if needed
32°F, or below is imminent;	Dry	Apply liquid or Pre-Wet Solid	15-35	Plow as needed; reapply liquid Chemical when needed	15-35	*Application rates will depend on dilution potential
ALSO 20 to 32°F, Remaining in range	Wet, slush, or light snow cover		20-40		20-40	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		30-65		30-65	* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICIER: See Sodium Chloride for application recommendations

Table 2. Weather event: LIGHT SNOW STORM WITH PERIOD (S) OF MODERATE OR HEAVY SNOW

Using a 32% concentration of *Calcium Chloride*

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid CaCl ₂	Maintenance Action	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R
32°F, or below is imminent;	Dry	Apply liquid Or Pre-Wet Solid	15-35	Plow as needed; reapply liquid Chemical when needed	*Do not apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential
ALSO 20 to 32°F, Remaining in range	Wet, slush, or light snow cover		20-40		
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		30-70		* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICIER: See Sodium Chloride for application recommendations.

Table 3. Weather event: MODERATE OR HEAVY SNOW STORM

Using a 32% concentration of Calcium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/lb-mi)	Maintenance Action	Chemical spread rate (gal/lb-mi)	
			Liquid CaCl ₂		Liquid CaCl ₂	N/R=Not Recommended
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM plow if needed
32°F, or below is imminent;	Dry	Apply liquid or Pre-Wet solid	N/R	Plow accumulation and reapply pre-wet solid chemical as needed	N/R	* If sufficient moisture is present, solid chemical without pre-wetting can be applied * Do not apply liquid chemical onto heavy snow accumulation or packed snow
ALSO 20 to 32°F, Remaining in range	Wet, slush, or light snow cover		N/R		N/R	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		N/R		N/R	
Below 15°F, Steady or falling	Dry or light snow cover	Plow accumulation as needed	N/R	Plow accumulation as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to prevent deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICIER: See Sodium Chloride for application recommendations.

Table 4. Weather event: FROST OR BLACK ICE
Using a 32% concentration of Calcium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	TRAFFIC CONDITION	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
		Maintenan ce Action	Chemical spread rate (gal/l _n -mi) Liquid CaCl ₂	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid CaCl ₂	N/R=Not Recommended
32°F, Steady or rising	Any level	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32°F or below and is at or below dew point
28 to 32°F, Remaining in range or falling 32°F or below, <i>and</i> equal to or below dew point	Traffic rate less than 100 vehicles per hour	Apply liquid chemical	10-25	Reapply liquid chemical as needed	10-25	* Application rates will depend on dilution potential
	Traffic rate greater than 100 vehicles per hour		20-35		20-35	
15 to 28°F, Remaining in range, <i>and</i> equal to or below dew point	Any level		20-40		25-40	* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Any level	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 5. Weather event: FREEZING RAINSTORM

Using a 30% concentration of Magnesium Chloride

Using a 32% Calcium Chloride

Using a 25% concentration of CMA

CHEMICAL APPLICATIONS: It is possible to use these chemicals during this event but is not recommended. However, these products can be used through a pre-wet system to increase solid / abrasive efficacy. The application rate for liquids alone would be cost prohibitive and the potential for dilution is high. It is recommended to use a solid chemical application or abrasives.

Using Solid Sodium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate (lb/l ⁿ -mi) NaCl	Maintenance Action	Chemical spread rate (lb/l ⁿ -mi) NaCl	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	* Monitor pavement temperature closely *Treat icy patches if needed with pre-wetted solid chemical at 100--150 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	100-200	Reapply solid chemical as needed	100-200	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
20 to 32°F, Remaining in range		200-300		200-300	
15 to 20°F, Remaining in range		250-400		250-400	
Below 15°F, Steady or falling	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 6. Weather event: SLEET STORM

Using a 32% concentration of Calcium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Liquid CaCl ₂	Maintenance Action	Liquid CaCl ₂	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	Go to Sodium Chloride Chart
32°F, or below is imminent	Apply solid NaCl or Pre-Wet Solid	N/R	Plow accumulation and reapply pre-wet solid chemical as needed	N/R	
28 to 32°F, Remaining in range					
15 to 28°F, Remaining in range					
Below 15°F, Steady or falling	Plow as needed	N/R	Plow as needed	N/R	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 1. Weather event: LIGHT SNOW

Using a 30% concentration of Magnesium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM... plow if needed
32°F, or below is imminent;	Dry	Apply liquid or Pre-Wet Solid	15-35	Plow as needed; reapply liquid chemical when needed	15-35	*Application rates will depend on dilution potential
ALSO 20 to 32°F, Remaining in range	Wet, slush, or light snow cover		20-40		20-40	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		45-65		45-65	* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to prevent deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICIER: See Sodium Chloride for application recommendations.

Table 2. Weather event: LIGHT SNOW STORM WITH PERIOD (S) OF MODERATE OR HEAVY SNOW

Using a 30% concentration of Magnesium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM... plow if needed
32°F, or below is imminent;	Dry	Apply liquid or Pre-Wet solid	15-35	Plow as needed; reapply liquid chemical when needed	15-35	
ALSO 20 to 32°F, Remaining in range	Wet, slush, or light snow cover		20-40		20-40	*Application rates will depend on dilution potential
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		45-70		45-70	* Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICIER: See Sodium Chloride for application recommendations.

Table 3. Weather event: MODERATE OR HEAVY SNOW STORM

Using a 30% concentration of Magnesium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION			SUBSEQUENT OPERATIONS		COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 15-35 GPLM plow if needed
32°F, or below is imminent;	Dry	Apply liquid Pre-Wet Solid	N/R	Plow accumulation and reapply pre-wet solid chemical as needed	N/R	* If sufficient moisture is present, solid chemical without pre-wetting can be applied * Do not apply liquid chemical onto heavy snow accumulation or packed snow
ALSO 20 to 32°F, Remaining in range	Wet, slush, or light snow cover		N/R		N/R	
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover		N/R		N/R	
Below 15°F, Steady or falling	Dry or light snow cover	Plow accumulation as needed	N/R	Plow accumulation as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

SOLID DEICIER: See Sodium Chloride for application recommendations.

Table 4. Weather event: FROST OR BLACK ICE

Using a 30% concentration of Magnesium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	TRAFFIC CONDITION	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
		Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	Maintenance Action	Chemical spread rate (gal/l _n -mi) Liquid MgCl ₂	N/R=Not Recommended
32°F, Steady or rising	Any level	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32°F or below and is at or below dew point
28 to 32°F, Remaining in range or falling 32°F or below, <i>and</i> equal to or below dew point	Traffic rate less than 100 vehicles per hour	Apply liquid chemical	15-35	Reapply liquid chemical as needed	15-30	* Application rates will depend on dilution potential
	Traffic rate greater than 100 vehicles per hour		20-35		20-35	
15 to 28°F, Remaining in range, <i>and</i> equal to or below dew point	Any level		25-40		25-40	* Application rates will depend on dilution potential
Below 15°F, Steady or falling		Apply abrasives as needed	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 5. Weather event: FREEZING RAINSTORM

Using a 30% concentration of Magnesium Chloride

Using a 32% concentration of Calcium Chloride

Using a 25% concentration of CMA

CHEMICAL APPLICATIONS: It is possible to use these chemicals during this event but is not recommended. However, these products can be used through a pre-wet system to increase solid / abrasive efficacy. The application rate for liquids alone would be cost prohibitive and the potential for dilution is high. It is recommended to use a solid chemical application or abrasives.

Using Solid Sodium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate (lb/l ⁿ -mi) NaCl	Maintenance Action	Chemical spread rate (lb/l ⁿ -mi) NaCl	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	* Monitor pavement temperature closely * Treat icy patches if needed with pre-wetted solid chemical at 100--150 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	100-200	Reapply solid chemical as needed	100-200	* Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
20 to 32°F, Remaining in range		200-300		200-300	
15 to 20°F, Remaining in range		250-400		250-400	
Below 15°F, Steady or falling	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 6. Weather event: SLEET STORM

Using a 30% concentration of Magnesium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Liquid MgCl ₂	Maintenance Action	Liquid MgCl ₂	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	Go to Sodium Chloride Chart
32°F, or below is imminent	Apply solid NaCl	N/R	Plow accumulation and reapply pre-wet solid chemical as needed	N/R	
28 to 32°F, Remaining in range					
15 to 28°F, Remaining in range					
Below 15°F, Steady or falling	Plow as needed	N/R	Plow as needed	N/R	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 1. Weather event: LIGHT SNOW

Using a 23% concentration of Sodium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of Initial operation	Maintenance action	Chemical spread rate (gal/lb-mi or lb/lb-mi)		Maintenance action	Chemical spread rate (gal/lb-mi or lb/lb-mi)		N/R=Not Recommended
			Liquid NaCl	Solid or pre-wet solid (lb)		Liquid NaCl	Solid or pre-wet solid (lb)	
Above 32°F , Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 100 lb/lane-mi; plow if needed
32°F , or below is imminent;	Dry	Apply liquid or pre-wet solid chemical	40-50	75-125	Plow as needed; reapply liquid or solid chemical when needed	40-50	75-125	*Application rates will depend on dilution potential
<i>ALSO</i> 20 to 32°F , Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	40-90	100-210		40-90	100-210	
15 to 20°F , Remaining in range	Dry, wet, slush, or light snow cover	Apply pre-wet solid chemical	N/R	200-240	Plow as needed; reapply pre-wet solid chemical when needed	N/R	200-240	*If sufficient moisture is present, solid chemical without pre-wetting can be applied *Application rates will depend on dilution potential
Below 15°F , Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 2. Weather event: LIGHT SNOW STORM WITH PERIOD (S) OF MODERATE OR HEAVY SNOW

Using a 23% concentration of *Sodium Chloride*

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS					COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/ln-mi or lb/ln-mi)		Maintenance Action	Chemical spread rate (gal/ln-mi or lb/ln-mi)				N/R=Not Recommended
			Liquid NaCl	Solid or pre-wet Solid		Liquid NaCl		Solid or pre-wet solid		
						Light snow	Heavier snow	Light snow	Heavier snow	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R				*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 40-65 GPLM; plow if needed
32°F, or below is imminent;	Dry	Apply liquid or pre-wet solid chemical	40-65	75-150	Plow as needed; reapply liquid or solid chemical when needed	40-50	50-65	75-125	150-200	*Do not apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential
ALSO 25 to 32°F, Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	65-90	175-200		65-80	80-90	175-185	190-200	
15 to 25°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply pre-wet solid chemical	N/R	200-230	Plow as needed; reapply pre-wet solid chemical when needed	N/R		200-230	200-250	* If sufficient moisture is present, solid chemical without pre-wetting can be applied * Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R				* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 3. Weather event: *MODERATE OR HEAVY SNOW STORM*

Using a 23% concentration of *Sodium Chloride*

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/l _n -mi or lb/l _n -mi)		Maintenance Action	Chemical spread rate (gal/l _n -mi or lb/l _n -mi)		N/R=Not Recommended
			Liquid NaCl	Solid or pre-wet Solid		Liquid NaCl	Solid or pre-wet solid	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 40-65 GPLM; plow if needed
32°F, or below is imminent;	Dry	Apply liquid or pre-wet solid chemical	40-65	75-150	Plow accumulation and reapply liquid or pre-wet solid chemical as needed	50-65	150-200	*Do not apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential
ALSO 25 to 32°F, Remaining in range	Wet, slush, or light snow cover	Apply solid chemical	N/R	175-200	Plow accumulation and reapply pre-wet solid chemical as needed	80-90	190-200	
15 to 25°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply pre-wet solid chemical	N/R	200-230	Plow as needed; reapply pre-wet solid chemical when needed	N/R	200-250	* If sufficient moisture is present, solid chemical without pre-wetting can be applied * Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 4. Weather event: FROST OR BLACK ICE

Using a 23% concentration of Sodium Chloride

PAVEMENT TEMPERATURE RANGE, TREND	TRAFFIC CONDITION	INITIAL OPERATION			SUBSEQUENT OPERATIONS			COMMENTS
		Maintenance Action	Chemical spread rate (gal/l ⁿ -mi or Lb/l ⁿ -mi)		Maintenance Action	Chemical spread rate (gal/l ⁿ -mi or lb/l ⁿ -mi)		N/R=Not Recommended
			Liquid NaCl	Solid or pre-wet solid		Liquid NaCl	Solid or pre-wet solid	
32°F, Steady or rising	Any level	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32°F or below and is at or below dew point
28 to 32°F, Remaining in range or falling 32°F or below, <i>and</i> equal to or below dew point	Traffic rate less than 100 vehicles per h	Apply liquid or pre-wet solid chemical	45-60	100-130	Reapply liquid or pre-wet solid chemical when needed	45-60	100-130	* Application rates will depend on dilution potential
	Traffic rate greater than 100 vehicles per h		45-75	100-130		45-75	100-130	
20 to 28°F, Remaining in range, <i>and</i> equal to or below dew point	Any level		65-80	165-200		65-80	165-200	* Application rates will depend on dilution potential
15 to 20°F, Remaining in range, <i>and</i> equal to or below dew point		Apply pre-wet solid chemical	N/R	175-225	Reapply pre-wet solid chemical when needed	N/R	175-225	
Below 15°F, Steady or falling		Apply abrasives	N/R		Apply abrasives as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 5. Weather event: FREEZING RAINSTORM

Using a 30% concentration of Magnesium Chloride

Using a 32% concentration of Calcium Chloride

Using a 25% concentration of CMA

CHEMICAL APPLICATIONS: It is possible to use these chemicals during this event but is not recommended. However, these products can be used through a pre-wet system to increase solid / abrasive efficacy. The application rate for liquids alone would be cost prohibitive and the potential for dilution is high. It is recommended to use a solid chemical application or abrasives.

Using Solid Sodium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate (lb/ln-mi) NaCl	Maintenance Action	Chemical spread rate (lb/ln-mi) NaCl	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	* Monitor pavement temperature closely *Treat icy patches if needed with pre-wetted solid chemical at 100--150 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	100-200	Reapply solid chemical as needed	100-200	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
20 to 32°F, Remaining in range		200-300		200-300	
15 to 20°F, Remaining in range		250-400		250-400	
Below 15°F, Steady or falling	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 6. Weather event: SLEET STORM

Using a 23% concentration of Sodium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate, lb/lane-mi NaCl	Maintenance Action	Chemical spread rate, lb/lane-mi NaCl	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	* Monitor pavement temperature closely *Treat icy patches if needed with pre-wetted solid chemical at 100-150 lb/lane-mi
32°F, or below is imminent	Apply solid chemical or Pre-Wet Solid	125	Plow accumulation and reapply pre-wet solid chemical as needed	125	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
28 to 32°F, Remaining in range		125-325		125-325	
15 to 28°F, Remaining in range		250-400		250-400	
Below 15°F, Steady or falling	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 1. Weather event: LIGHT SNOW

Using a 25% concentration of CMA

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of Initial operation	Maintenance action	Chemical spread rate (gal/l _n -mi or lb/l _n -mi)		Maintenance action	Chemical spread rate (gal/l _n -mi or lb/l _n -mi)		N/R=Not Recommended
			Liquid CMA	Solid or pre-wet solid (lb)		Liquid CMA	Solid or pre-wet solid (lb)	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 30- 45 GPLM
32°F, or below is imminent;	Dry	Apply liquid or pre-wet solid chemical	30-45	75-125	Plow as needed; reapply liquid or solid chemical when needed	30-45	75-125	*Application rates will depend on dilution potential
ALSO 20 to 32°F, Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	40-60	100-150		40-60	75-150	*Application rates will depend on dilution potential
15 to 20°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply pre-wet solid NaCl	N/R	200-240	Plow as needed; reapply solid NaCl when needed	N/R	200-240	*If sufficient moisture is present, solid chemical without pre-wetting can be applied *Application rates will depend on dilution potential
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 2. Weather event: LIGHT SNOW STORM WITH PERIOD (S) OF MODERATE OR HEAVY SNOW

Using a 25% concentration of CMA

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS						COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/l _n -mi or lb/l _n -mi)		Maintenance Action	Chemical spread rate (gal/l _n -mi or lb/l _n -mi)					
			Liquid CMA	Solid or pre-wet Solid		Liquid CMA		Solid or pre-wet solid			
						Light snow	Heavier snow	Light snow	Heavier snow	N/R=Not Recommended	
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R					* Monitor pavement temperature closely *Treat icy patches if needed with chemical at 20-40 GPLM; plow if needed
32°F, or below is imminent;	Dry	Apply liquid or pre-wet solid chemical	35-60	150-200	Plow as needed; reapply liquid or solid chemical when needed	40-60	N/R	150-200	N/R		*Do not apply liquid chemical onto heavy snow accumulation or packed snow * Application rates will depend on dilution potential
ALSO 25 to 32°F, Remaining in range	Wet, slush, or light snow cover	Apply liquid or solid chemical	40-70	150-200		40-70	N/R	150-200	N/R		
15 to 25°F, Remaining in range	Dry, wet, slush, or light snow cover	Apply pre-wet solid NaCl	N/R		Plow as needed; reapply pre-wet solid chemical when needed	N/R					
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R				* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction	

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 3. Weather event: *MODERATE OR HEAVY SNOW STORM*

Using a 25% concentration of CMA

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION				SUBSEQUENT OPERATIONS			COMMENTS
	Pavement surface at time of Initial operation	Maintenance Action	Chemical spread rate (gal/lb-mi or lb/lb-mi)		Maintenance Action	Chemical spread rate (gal/lb-mi or lb/lb-mi)		
			Liquid CMA	Solid or pre-wet Solid		Liquid CMA	Solid or pre-wet solid	N/R=Not Recommended
Above 32°F, Steady or rising	Dry, wet, slush, or light snow cover	None, see comments	N/R		None, see comments	N/R		*Monitor pavement temperature closely *Treat icy patches if needed with chemical at 35-45 GPLM; plow if needed
32°F, or below is imminent;	Dry	Apply liquid or pre-wet solid chemical	40-70	150-200	Plow as needed; reapply liquid or solid chemical as needed	40-70	150-200	*Do not apply liquid chemical onto heavy snow accumulation or packed snow *Application rates will depend on dilution potential * If sufficient moisture is present, solid chemical without pre-wetting can be applied
ALSO 25 to 32°F, Remaining in range	Wet, slush, or light snow cover	Apply pre-wet solid NaCl	N/R		Plow accumulation and reapply pre-wet solid chemical as needed	N/R		* If sufficient moisture is present, solid chemical without pre-wetting can be applied
15 to 25°F, Remaining in range	Dry, wet, slush, or light snow cover		N/R			N/R		
Below 15°F, Steady or falling	Dry or light snow cover	Plow as needed	N/R		Plow as needed	N/R		* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 4. Weather event: FROST OR BLACK ICE

Using a 25% concentration of CMA

PAVEMENT TEMPERATURE RANGE, TREND	TRAFFIC CONDITION	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
		Maintenance Action	Chemical spread rate (gal/l ⁿ -mi) Liquid CMA	Maintenance Action	Chemical spread rate (gal/l ⁿ -mi) Liquid CMA	N/R=Not Recommended
32°F, Steady or rising	Any level	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely; begin treatment if temperature starts to fall to 32°F or below and is at or below dew point
28 to 32°F, Remaining in range or falling 32°F or below, <i>and</i> equal to or below dew point	Traffic rate less than 100 vehicles per h	Apply liquid chemical	25-35	Reapply liquid chemical as needed	25-35	* Application rates will depend on dilution potential
	Traffic rate greater than 100 vehicles per h		30-45		25-40	
20 to 28°F, Remaining in range, <i>and</i> equal to or below dew point	Any level		35-50		35-50	* Application rates will depend on dilution potential
15 to 20°F, Remaining in range, <i>and</i> equal to or below dew point	Any level	Apply pre-wet solid NaCl	N/R	Reapply pre-wet solid chemical when needed	N/R	
Below 15°F, Steady or falling	Any level	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 5. Weather event: FREEZING RAINSTORM

Using a 30% concentration of Magnesium Chloride

Using a 32% concentration of Calcium Chloride

Using a 25% concentration of CMA

CHEMICAL APPLICATIONS: It is possible to use these chemicals during this event but is not recommended. However, these products can be used through a pre-wet system to increase solid / abrasive efficacy. The application rate for liquids alone would be cost prohibitive and the potential for dilution is high. It is recommended to use a solid chemical application or abrasives.

Using Solid Sodium Chloride

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate (lb/l _n -mi) NaCl	Maintenance Action	Chemical spread rate (lb/l _n -mi) NaCl	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	* Monitor pavement temperature closely *Treat icy patches if needed with pre-wetted solid chemical at 100--150 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	100-200	Reapply solid chemical as needed	100-200	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
20 to 32°F, Remaining in range		200-300		200-300	
15 to 20°F, Remaining in range		250-400		250-400	
Below 15°F, Steady or falling	Apply abrasives	N/R	Apply abrasives as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.

Table 6. Weather event: SLEET STORM

Using a 25% concentration of CMA

PAVEMENT TEMPERATURE RANGE, AND TREND	INITIAL OPERATION		SUBSEQUENT OPERATIONS		COMMENTS
	Maintenance Action	Chemical spread rate, lb/lane-mi\ CMA	Maintenance Action	Chemical spread rate, lb/lane-mi CMA	N/R=Not Recommended
Above 32°F, Steady or rising	None, see comments	N/R	None, see comments	N/R	*Monitor pavement temperature closely for drops toward 32°F and below *Treat icy patches if needed with solid chemical at 125 lb/lane-mi
32°F, or below is imminent	Apply solid chemical	150-200	Plow accumulation and reapply pre-wet solid chemical as needed	150-200	*Monitor pavement temperature and precipitation closely * Application rates will depend on dilution potential
28 to 32°F, Remaining in range	Apply solid NaCl	N/R		N/R	Go to Sodium Chloride Chart
15 to 28°F, Remaining in range		N/R		N/R	
Below 15°F, Steady or falling	Plow as needed	N/R	Plow as needed	N/R	* It is not recommended that chemicals be applied in this temperature range * Abrasives can be applied to enhance traction

CHEMICAL APPLICATIONS: These application rates are starting points. Local experience should refine these recommendations. Time chemical applications to *prevent* deteriorating conditions or development of packed and bonded snow. Monitor temperature and humidity to determine application timing.

PLOWING: Before applying any ice control chemical, the surface should be cleared of as much snow and ice as possible

CHEMICAL RATES: The recommended snow and ice control material application rates depend on atmospheric and pavement conditions at the time of treatment and on how these conditions are expected to change over the time period (window) between the current treatment and the next anticipated treatment.